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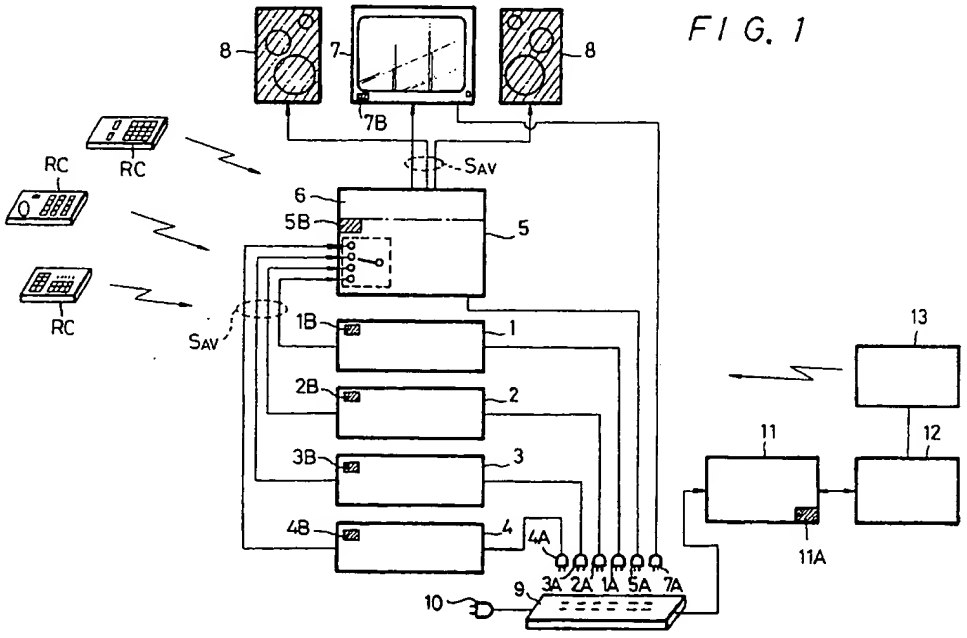
(54) Power status detecting apparatus.

(57) A power status detecting apparatus to be applied to a plurality of audio-visual equipments (1 to 5, 7) is arranged such that currents flowing to AC lines (1A to 5A, 7A) of the respective equipments (1 to 5, 7) are detected (11) so as to identify the power condition status of the respective equipments (1 to 5, 7) and in which identified information are supplied to a system control apparatus (12).

FIG. 1



EP 0 398 550 A2

This invention relates to power status detecting apparatus. Embodiments of the invention can, for example, be used with domestic audio and/or video equipment which is powered by an AC mains supply, and which can be controlled by a remote controller.

Generally, in equipments which are to be controlled by a remote controller, a power switch is turned ON and OFF by a power control signal from the remote controller. That is, a toggle switch operation is accomplished.

When a user controls various audio-visual apparatus such as a video tape recorder (VTR), a compact disc (CD) player, a laser disc (LD) player, a tuner or a tape deck by a remote controller, the user looks to check if the power is ON or OFF on the various units. For example, if initially the power switch of a television receiver is OFF, the user has to depress a power switch of the remote controller for the television receiver so as to turn its power switch ON, and then the user selects a certain television channel to watch.

However, when certain equipment is required to be controlled by the user of a system control apparatus, if its power status is not clear, then it is unclear whether a first power source control command should be issued by the system control apparatus.

To remove this disadvantage, a bidirectional control bus system such as a so-called home bus system has recently been proposed. With such a bus system, the power status of each apparatus can be automatically identified by using bus lines, such that a so-called interlocking system operation is possible.

More precisely, when the user wants to play, for example, a VTR, by pushing a play button of a remote controller for the VTR directly, it is possible automatically to turn ON equipments necessary for the playing back operation of the VTR, and which include, for example, a television monitor receiver, a VTR and an audio amplifier, so that the play operation of the VTR will start. In this case, unnecessary equipments such as a compact disc (CD) player or the like will have their power switches automatically turned OFF.

In older types of equipments which do not have a home bus terminal, however, system control such as described above cannot be accomplished.

According to the present invention there is provided a power status detecting apparatus which can be applied to a plurality of audio-visual equipments, the apparatus comprising:

a plurality of AC outlets to which the power plugs of said plurality of audio-visual equipments are connected;

means connected to each of said AC outlets for detecting AC currents at each of said AC outlets; and

means connected to said AC current detecting means for determining the power condition status of said respective audio-visual equipments.

The invention will now be described by way of example with reference to the accompanying drawings, throughout which like parts are referred to by like references, and in which:

Figure 1 is a schematic diagram showing a first embodiment of power status detecting apparatus according to the present invention;

Figures 2A and 2B are diagrams used to explain the operation of the embodiment of Figure 1;

Figures 3 and 4 are block circuit diagrams of part of an embodiment;

Figure 5 is a flow chart to which reference will be made for explaining the operation;

Figure 6 is a schematic diagram showing a second embodiment of power status detecting apparatus according to the present invention;

Figure 7 is a block circuit diagram of part of the embodiment of Figure 6;

Figure 8 is a flow chart to which reference will be made for explaining the operation;

Figure 9 is a schematic diagram showing a third embodiment of power status detecting apparatus according to the present invention; and

Figure 10 is a block circuit diagram of part of the embodiment of Figure 9.

Referring to Figure 1, the first embodiment of power status detecting apparatus is connected to an audio-visual (AV) system comprising a compact disc (CD) player 1, a television (TV) tuner 2, a video tape recorder (VTR) 3 and a laser disc (LD) player 4. An audio or video signal S_{AV} from these audio-visual equipments is supplied to a selector 5, and thence through a main amplifier 6 therein to a monitor television receiver 7 or to loudspeakers 8 where it is reproduced as audio and/or a video picture.

There are provided remote controllers RC which can effect remote control operation by transmitting infra-red remote control signals. Generally, the audio-visual equipments are provided with respective remote controllers, which transmit infra-red remote control signals to the corresponding audio-visual equipments For this purpose, the audio-visual equipments are provided with light receiving means 1B, 2B, 3B, 4B, 5B and 7B, respectively.

There is provided a power block 9 in which there can be inserted power source plugs 1A, 2A, 3A, 4A, 5A and 7A of the respective audio-visual equipments. The power block 9 has a main power plug 10. The power status of the audio-visual equipments are controlled in a toggle-fashion in response to the power control signals from the

remote controllers RC.

A power status detecting apparatus 11 detects the power status of the respective audio-visual equipments. The detecting apparatus 11 includes a receiving portion 11A which receives the remote control signals from the respective remote controllers RC.

The remote control signal used in this embodiment will be described. The remote control signal is transmitted from the remote controller RC in the form of a command and an identification (ID) signal for the equipment. Accordingly, the signal from the remote controller RC of, for example, the VTR 3 is effective only to control the VTR 3. However, the receiving portion 11A of the detecting apparatus 11 can receive the remote control signals from the remote controllers RC of all of the equipments. A system control apparatus 12 is capable of transmitting a command signal to the detecting apparatus 11 and is capable of receiving a signal from the detecting apparatus 11 corresponding to the respective audio-visual apparatuses. A transmitting portion 13 is connected to the system control apparatus 12 so as to transmit infra-red remote control signals to the respective audio-visual equipments.

The detecting apparatus 11 determines a threshold value, which is an intermediate value between a current value corresponding to power source OFF and a current value corresponding to power source ON when the power status is changed from OFF to ON as shown in Figure 2A. It also determines a threshold value, which is an intermediate value between a current value corresponding to power source OFF when the power status is changed from ON to OFF as shown in Figure 2B. The detecting apparatus 11 then identifies that the power of the equipment is ON if the detected current value is larger than the threshold value, and that the power of the equipment is OFF if the detected current is smaller than the threshold value.

The signal which indicates the power status is supplied to the system control apparatus 12 which responds to the remote control signal received at the receiving portion 11A to effect various system control operations on the basis of the power status of the respective equipments as follows: If the user does not want some equipments which are in the ON-state to be ON, the power of the corresponding equipments are turned OFF by the power control signal from the transmitting portion 13. If the user wants some equipments which are in the OFF state to be ON, then the power of the equipments which are desired to be ON, are turned ON by the power control signal from the transmitting portion 13 under the control of the system control apparatus 12.

Figure 3 shows an example of a practical circuit arrangement of the detecting apparatus 11 of Figure 1. The detecting apparatus 11 comprises a current detecting portion 20 which is connected to an analogue-to-digital (A/D) converter 21. A microprocessor 22 is connected to the A/D converter 21 and is connected to a buffer memory 23 which stores an initial value of the power source currents which correspond to each of the equipments. A second buffer memory 24 which stores threshold current values corresponding to each of the equipments is also connected to the microprocessor 22, as also is a buffer memory 25 in which codes of various control signals of the respective equipments are stored as data bases. A fourth buffer memory 26 in which data corresponding to ports connected to the respective equipments are stored is also connected to the microprocessor 22.

Figure 4 illustrates a part of the current detecting portion 20 shown in Figure 3, which corresponds to the audio visual equipment.

As shown in Figure 4, outlets 30 mounted in the power block 9 (Figure 1), are connected to the main power source plug 10, and diodes 31 and 32 which have opposing polarities have first sides connected to one of two lines which connect the outlet 30 and the main power source plug 10. A transformer 33 is connected in parallel with the diodes 31 and 32. A full-wave rectifying circuit 34 of bridge type is connected to the secondary of the transformer 33, and a capacitor 35 is connected across the output side of the rectifying circuit 34.

In the current detecting section 20 of Figure 3, a current is detected and is supplied to the A/D converter 21, where it is converted from an analogue signal to a digital signal, and is then fed to the microprocessor 22. In the microprocessor 22, the threshold values necessary for identifying the power status of the respective equipments which are connected to the outlets 30 of the power block 9 are detected for every equipment and are then stored. A flow chart forming Figure 5 is used to explain the manner of determining the threshold values.

Initially, the manner determining the threshold value for the CD player 1 will be described. A current control command is issued from the remote controller RC to the CD player 1. The current control command which has been transmitted is received by the remote control signal receiving portion 1B of the CD player 1, and is also received by the receiving portion 11A of the power status detecting apparatus 11.

As shown in Figure 5, after the start of operation, the changes of current values at respective outlets 30 of the power block 9 are measured in step 40. Then, the processing by the microprocessor 33 proceeds to the next decision step 41. In step 41, the current values measured in step 40

are compared with initial values which have been previously measured, and it is determined whether or not changes of current values at the respective outlets 30 have occurred. If it is determined that no change of current value has occurred which is represented by a NO at step 41, then the processing by the microprocessor 22 proceeds to the next decision step 42. In decision step 42, it is determined whether or not the measuring time exceeds a predetermined measuring time. If it is determined that a NO is output at step 42, then the processing by the microprocessor 22 returns to step 40, and the above-described operations are repeated. In that case, when the measuring time exceeds the predetermined measuring time, if it is determined that no changes of the current values have occurred at the respective outlets 30, it is determined that the CD player 1 is not connected to the power block 9 and processing is ended.

If on the other hand it is determined that changes of currents are detected as represented by a YES at step 41, then the processing proceeds to the next decision step 43. In step 43, it is determined whether or not the current change is stabilized. If it is determined that the current change has not yet stabilized as represented by a NO at step 43, then the processing by the microprocessor 22 returns to step 40, and the above-described operations are repeated. If it is determined that the current change has stabilized as represented by a YES at step 43, then the processing proceeds to step 44. In step 44, data which indicates the particular equipment for which the current value has changed (in this case, the CD player 1) and the corresponding outlet 30 which is connected to the CD player 1 are registered in the equipment data register buffer memory 26 based on the data in the buffer memory 25. Then, the processing of the microprocessor 22 proceeds to step 45, and a threshold value for the CD player 1 is computed using as a basis the initial current value and the present current value. Then, the threshold value for identifying the power status of the CD player 1 is stored in the buffer memory 24 and the processing by the microprocessor 22 is ended. Thus, the threshold value for the CD player 1 is determined as described above. Threshold values for the other equipments which are connected to the power block 9 are determined in a manner similar to that described above.

After the threshold values for identifying the power status of the respective equipments have been once determined as described above, the microprocessor 22 can easily identify the power status of the respective equipments on the basis of the outputs of the threshold buffer memory 24. In that case, in association with the buffer memory 26, the system control apparatus 12 can detect the relationship between the outlet 30 and the equipment which is connected thereto, if necessary.

The system control apparatus 12 controls the following system operation.

Referring back to Figure 1, when a power control command is transmitted from the remote controller RC, of, for example, the CD player 1 to the receiving portion 1B of the CD player 1, to cause power to the CD player 1 to be turned ON. Then, the detecting apparatus 11 identifies that the CD player 1 has been placed in the ON state. The power status detecting apparatus 11 supplies the system control apparatus 12 with data which indicates the power status of all equipment which are connected to the power block 9, including power status data which shows that the power source of the CD player 1 has been turned ON. The system control apparatus 12 performs various kinds of identifications and transmits commands necessary for the operation of the CD player 1 to the respective equipments from the transmitting portion 13. When the selector 5, for example, is supplied with a command for changing-over the input of the main amplifier 6 to the CD player 1, an audio signal from the CD player 1 is supplied to the main amplifier 6. Of course, in that case, the television tuner 2 is not needed so that, if the power of the television tuner 2 is in the ON state, then a current control command to turn the power of the television tuner 2 OFF is transmitted from the transmitting portion 13 to the receiving portion 2B of the television tuner 2, so that the power to the television tuner 2 will be turned OFF. As is clear from the first embodiment as described above, the currents which flow to the outlets of the respective equipments are detected so as to identify the power status of the equipments, and such identified information is supplied to the system control apparatus and is then used to effect succeeding system control operation.

Figure 6 shows a second embodiment of power status detecting apparatus according to the present invention. In this embodiment, the invention is applied to an audio-visual system. In Figure 6, like parts which correspond to those of Figure 1 are marked with the same reference numerals and will not again be described in detail.

In this embodiment, the power status detecting apparatus 11 is provided with a remote control signal transmitting portion 11B. The detecting apparatus 11 sequentially transmits from the remote control signal transmitting portion 11B power control signals for controlling the power of the respective audio-visual equipments and can identify the status with particular equipments and can set the power status identifying threshold values in a manner similar to that in the first embodiment shown in Figure 1. If the current detected is larger than such threshold value, it is identified that the power of

that apparatus is in the ON state, whereas if the current which is detected is smaller than the threshold value, it is identified that the power of that particular apparatus is in the OFF state. Then, the identified result is transmitted to the system control apparatus 12, where it is used to control the succeeding system control operation.

In the embodiment shown in Figure 6, the system control apparatus 12 is connected to a home bus 46 which is connected to equipments which have home bus terminals, such as, a multi-disc player 47, a selector with an amplifier 48 and the like. The selector 48 can select the respective equipments provided at the audio-visual side.

Figure 7 shows an example of a practical circuit arrangement of the detecting apparatus 11 used in the second embodiment shown in Figure 6. This circuit is substantially the same as that of Figure 3, and differs only in that, while the microprocessor 22 shown in the example of Figure 3 is provided with a remote control signal receiving portion 11A, the microprocessor 22 shown in the example of Figure 7 is provided with a remote control signal transmitting portion 11B as well as the remote control signal receiving portion 11A.

The microprocessor 22 is provided with the remote control signal transmitting portion 11B so that it can automatically determine the threshold values for the respective equipments.

Also in this case, the current which is detected by the current detecting portion 20 is supplied to the A/D converter 21, in which it is converted from an analogue signal to a digital signal, and it is then fed to the microprocessor 22. The microprocessor 22 is programmed so as automatically to determine the threshold values so as to identify the power statuses of the respective equipments. The manner of determining the threshold values will be described herein with reference to the flow chart of Figure 8.

Referring to Figure 8, following the start of operation, the processing by the microprocessor 22 proceeds to step 5. In step 50, a count value of a counter (not shown) provided within the microprocessor 22 is reset to zero (n = 0). Then, the processing of the microprocessor 22 proceeds to step 51, wherein power source current values of the respective equipments which are connected to the respective ports, that is, outlets are measured. In the next step 52, the count value n of the counter is incremented by one, and the processing of the microprocessor 22 proceeds to the next decision step 53. If n = 8 is not established as represented by a NO at step 53, then the processing of the microprocessor 22 returns to step 51, in which the described operations are repeated so as to measure the power source current values of the respective equipments.

If the count value of the counter is determined as n = 8 as represented by a YES at step 53, then the processing of the microprocessor 22 proceeds to step 54. In step 54, a mean value of eight power source current values with respect to the respective ports is computed, and the computed values are stored in the buffer memory 23' as initial values.

The processing by the microprocessor 22 proceeds to step 55, in which power control command data are generated from a remote control signal data base buffer memory 25. In the next step 56, a power control command signal (remote control signal) is generated from the transmitting portion 11B of the microprocessor 22. At step 57, power source current values of all equipments connected to the outlets 30 are measured.

The processing by the microprocessor 22 proceeds to the next decision step 58, in which it is determined whether or not the power source current values which were measured at step 57 have changed relative to the initial value. If they have not changed as represented by a NO at step 58, then the processing of the microprocessor 22 proceeds to the next decision step 59. In step 59, it is determined whether or not the measuring time exceeds the predetermined measuring time. If a NO is output at step 59, then the processing of the microprocessor 22 returns to step 57. Then, the above-described operations are repeated. If on the other hand, a YES is output at step 59, or if the measuring time exceeds the predetermined measuring time, then it is determined that the corresponding equipment is not connected to the outlet 30. Then, the processing of the microprocessor 22 proceeds to the next decision step 65.

If on the other hand it is determined that the power source current values measured at step 57 have changed as represented by a YES at step 58, then the processing by the microprocessor 22 proceeds to step 60. At step 60, the power source current values are again measured in order to remove unstable elements. Then, the processing of the microprocessor 22 proceeds to the next decision step 61. In step 61, it is determined whether or not changes of the power source current value have stabilized. If the change of the power source current value have not yet stabilized as represented by a NO at step 61, then the processing of the microprocessor 22 returns to step 59. If the changes of the power source current value have stabilized as represented by a YES at step 61, then the processing of the microprocessor 22 proceeds to step 62, in which data indicative of a correspondence between the power source port and the set, that is, data indicative of a correspondence between the outlet and the equipment connected to the outlet is registered in the equipment registration buffer memory 26.

Then, the processing of the microprocessor 22 proceeds to step 62, in which a threshold value which is used to identify the power status is computed on the basis of the previously-measured power source current value and is then stored in the buffer memory 24. The processing of the microprocessor 22 proceeds to the next decision step 64, in which it is determined whether or not the status of all of the ports have been determined. If the status of all ports have been determined as represented by a YES at step 64, then the processing of the microprocessor 22 proceeds to the next decision step 65. In step 65, it is determined whether or not the power status of all equipments have been checked. In other words, it is determined whether or not the power control signals have been generated for all equipments. If it is determined that all the equipments have not yet been checked as represented by a NO at step 65, then the processing of the microprocessor 22 returns to step 56. From step 56, the above-described operations are repeated. If it is determined that the checking of all the equipments has been finished as represented by a YES at step 65, then the processing of the microprocessor 22 ends.

When the condition that the threshold value for identifying the power status of each equipment has been determined, if the power of a certain equipment is turned ON from its OFF state by transmitting portion 11B of the power status detecting apparatus 11 or the corresponding remote controller RC of each equipment, then the current value which flows from the corresponding outlet will be changed. if this current value exceeds the above-described corresponding threshold value, the fact that the power of the corresponding equipment has been turned ON is transmitted to the system control apparatus 12.

An example of an application of the system control apparatus 12 shown in Figure 6 will be described below.

If the user wants to watch the television receiver and operates the television tuner remote controller RC so as to transmit the power source ON signal to the television tuner 2, then the fact that the power source of the television tuner 2 has been turned ON is detected by the power status detecting apparatus 11, and these data are supplied to the system control apparatus 12. The system control apparatus 12 identifies, on the basis of the information received, which one of the equipments should have their power turned ON and selects the corresponding equipment. For this case, the monitor television receiver 7 is turned ON. Then, by controlling the selector 48, the television tuner 2 is selected and is connected to the monitor television receiver 7. In this case, if the power of unnecessary equipment is in the ON state, the transmitting portion 11B generates a power control signal so that the power of the unnecessary equipment is turned OFF.

As described above, with the second embodiment of the invention, the currents flowing to the outlets of the respective equipments are detected, so as to identify the power status of the respective equipments and such identified information are supplied to the system control apparatus, so that the succeeding system control operations can be accomplished.

Figure 9 shows a third embodiment of the power status detecting apparatus according to the present invention, wherein the present invention is applied to an audio-visual system. In Figure 9, like parts which correspond to those of Figures 1 and 6 are marked with the same reference numerals and such portions will not be described in detail.

In the third embodiment, the power status detecting apparatus 11 is provided with a wired remote control signal transmitting portion 11B′ and the receiving portion 11A, and the respective equipments 1 and 4 are provided with one-direction wired remote control terminals. The remote control signal from the remote control signal transmitting portion 11B′ is received at the remote control terminals. Accordingly, a command such as a power source control command or the like is transmitted through the wired remote control line. If a command is transmitted to the existing equipment which have such remote control terminals through the wired remote control line, the existing equipment will be prevented from being affected by an external disturbance, and the existing equipment can be operated more positively.

Figure 10 shows an example of a practical circuit arrangement of the power status detecting apparatus used in the third embodiment shown in Figure 9.

As shown in Figure 10, the microprocessor 22 is provided with both of the remote control signal receiving portion 11A and the remote control signal transmitting portion 11B′, which is substantially similar to the equipment shown in Figure 7. If the respective equipments 1 to 4 are provided with wired remote control terminals, frequently the operation of the remote control signal receiving portions of the respective equipments do not work. As a result, the remote control signal received by the power status detecting apparatus 11 must be supplied to the wired remote control terminals of the respective equipments so that the microprocessor 22 needs both the remote control signal receiving portion 11A and the remote control signal transmitting portion 11B′.

In the practical circuit arrangement shown in Figure 10, there is provided a set status buffer memory 70 in which transmission commands are

classified and are then stored. With the employment of the set status buffer memory 70, the operation status of each of the sets except the power source status can be maintained so that the requirement of status information for each of the sets from the system control apparatus 12 can be satisfied.

If the playback state or the like of, for example, the VTR 3 is stored in the set status buffer memory 70, when the system control apparatus 12 requests the set status information, the set status information may be read out by the microprocessor 22 and transmitted to the system control apparatus 12.

In the system control apparatus 12, for example, the following application becomes possible.

When, for example, the remote control signal for turning the VTR 3 ON is generated from the remote controller RC of the VTR 3, this remote control signal is received at the receiving portion 11A of the power status detecting apparatus 11. This received signal is supplied to the system control apparatus 12, so that the monitor television receiver 7 is turned ON. Further, the system control apparatus 12 makes the selector 48 select the VTR 3 and drives the power status detecting apparatus 11 so as to cause power to the VTR 3 to be turned ON from the remote control signal transmitting portion 11B' via the wired remote control line. Thus, the signal reproduced by the VTR 3 can be received and reproduced by the monitor television receiver 7.

As set forth above, since the currents flowing through AC lines of the respective equipments are detected so as to identify the power status of the respective equipments and the identified information are supplied to the system control apparatus, system control of a plurality of the equipments can be positively and conveniently accomplished.

Furthermore, the invention is helpful for promoting a so-called bidirectional home-bus system, and in addition, when a home-bus system is available, the invention enables old type equipments to be controlled to some extent by the system control operation.

Claims

1. A power status detecting apparatus which can be applied to a plurality of audio-visual equipments (1 to 5, 7), the apparatus comprising:
a plurality of AC outlets (1A to 5A, 7A) to which the power plugs of said plurality of audio-visual equipments (1 to 5, 7) are connected;
means (11) connected to each of said AC outlets for detecting AC currents at each of said AC outlets; and
means (11) connected to said AC current detecting means for determining the power condition status of said respective audio-visual equipments.

2. Apparatus according to claim 1 wherein each of said plurality of audio-visual equipments (1 to 5, 7) has a receiving portion (1B to 5B, 7B) for receiving a remote control signal, and its power condition is controlled in a toggle switch manner by respective remote control signals to allow power control commands.

3. Apparatus according to claim 2 wherein said power condition status determining means (11) includes a remote control signal receiving portion (11A) for receiving remote control signals from various remote controllers (RC) of said audio-visual equipments (1 to 5, 7).

4. Apparatus according to claim 3 wherein said power condition status determining means (11) includes a threshold current memory (24) for said audio-visual equipments (1 to 5, 7) for storing threshold current values of said audio-visual equipments (1 to 5, 7).

FIG. 1

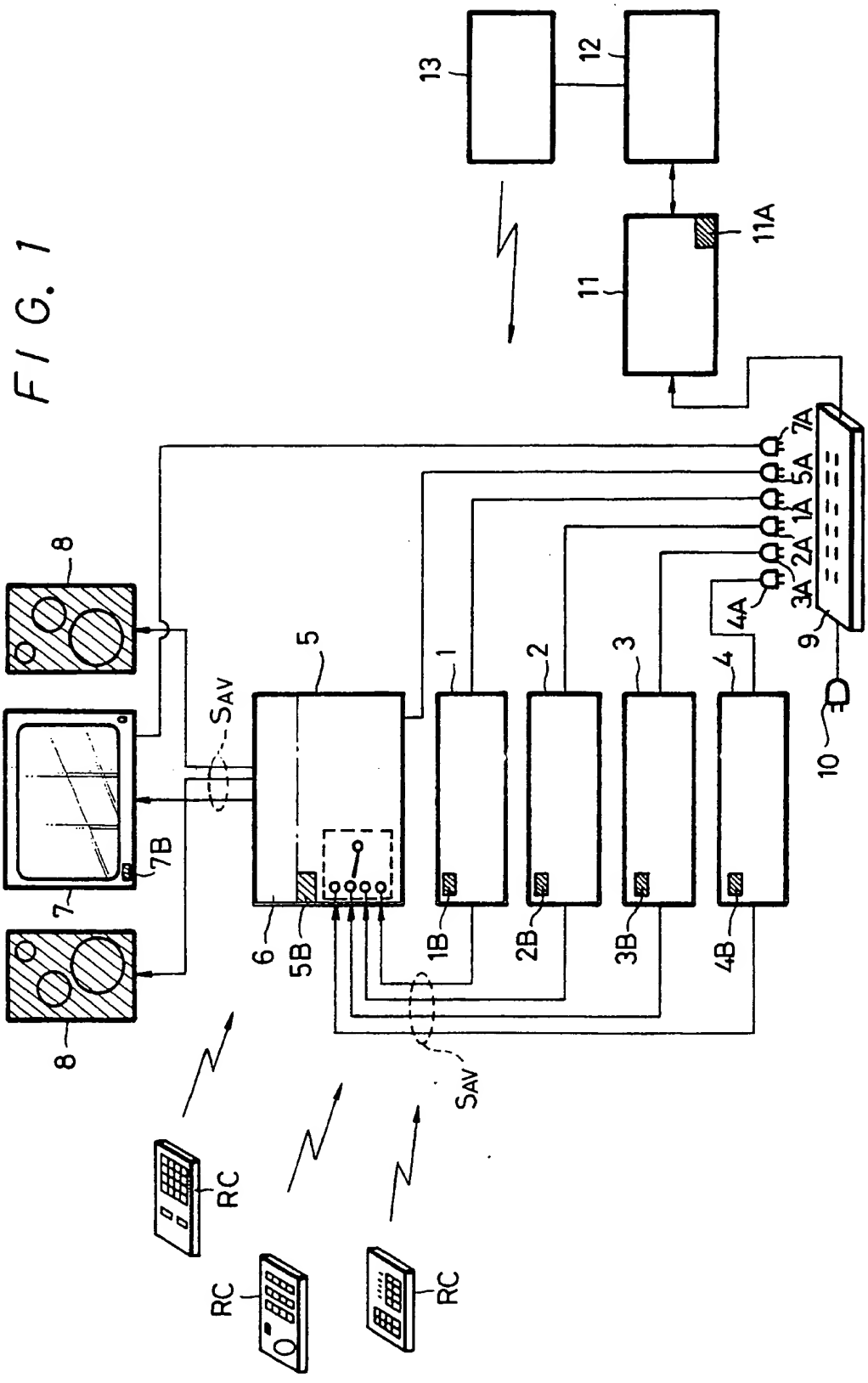

13
12
11
11A
7A
5A
1A
2A
3A
4A
9
10
8
8
7
7B
SAV
5
1
2
3
4
6
5B
1B
2B
3B
4B
SAV
RC
RC
RC

FIG. 2A

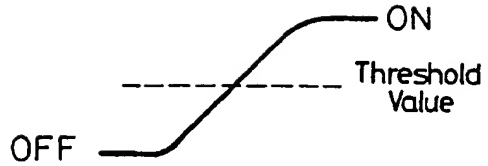


FIG. 2B

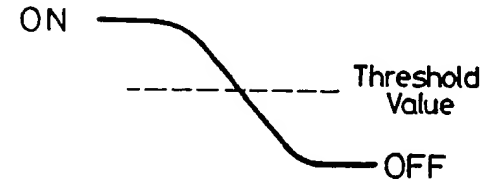


FIG. 3

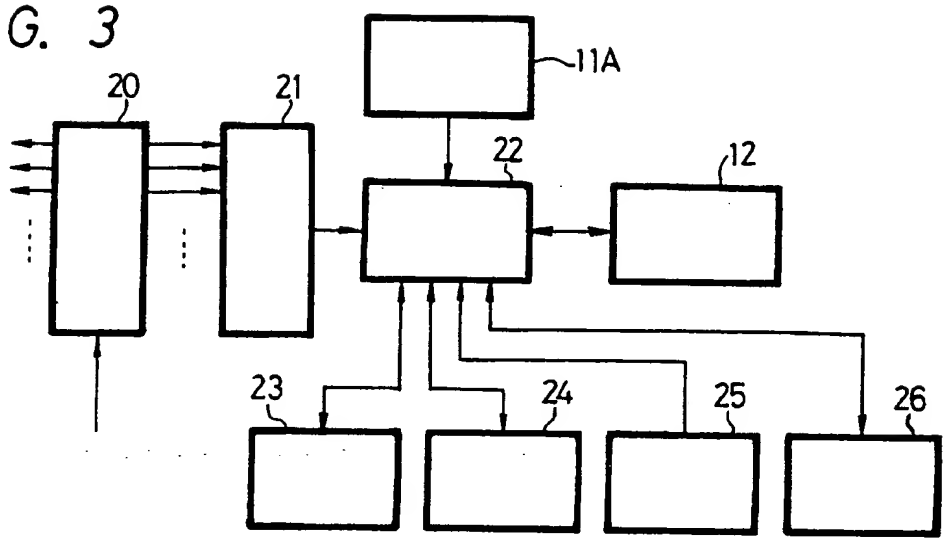


FIG. 4

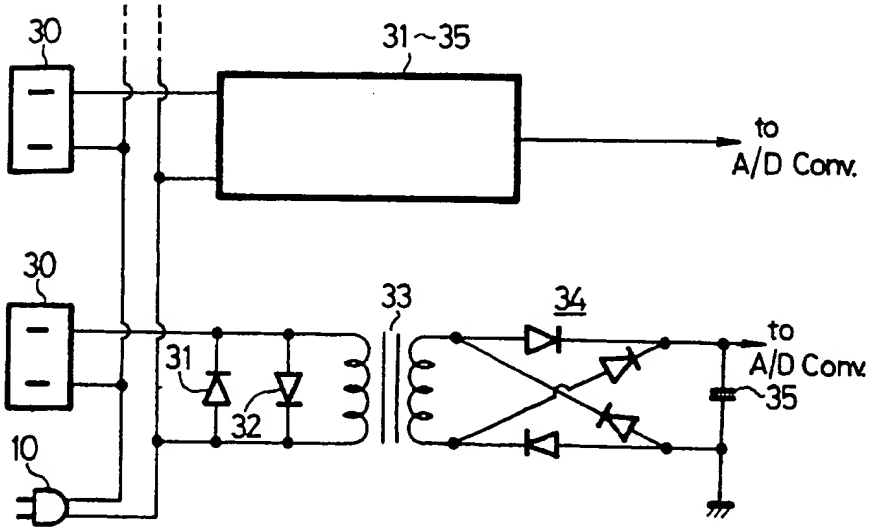


FIG. 5

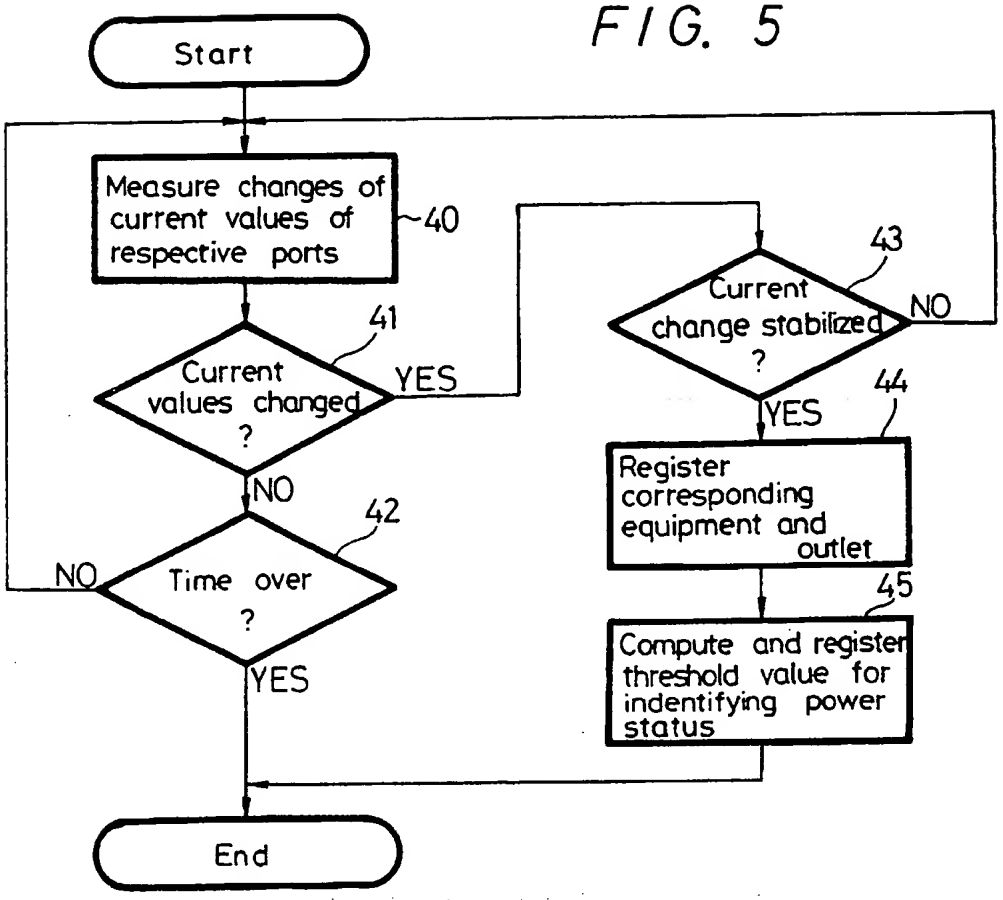

Start
Measure changes of current values of respective ports
40
41
Current values changed ?
YES
NO
42
Time over ?
NO
YES
End
43
Current change stabilized ?
NO
YES
44
Register corresponding equipment and outlet
45
Compute and register threshold value for indentifying power status

FIG. 7

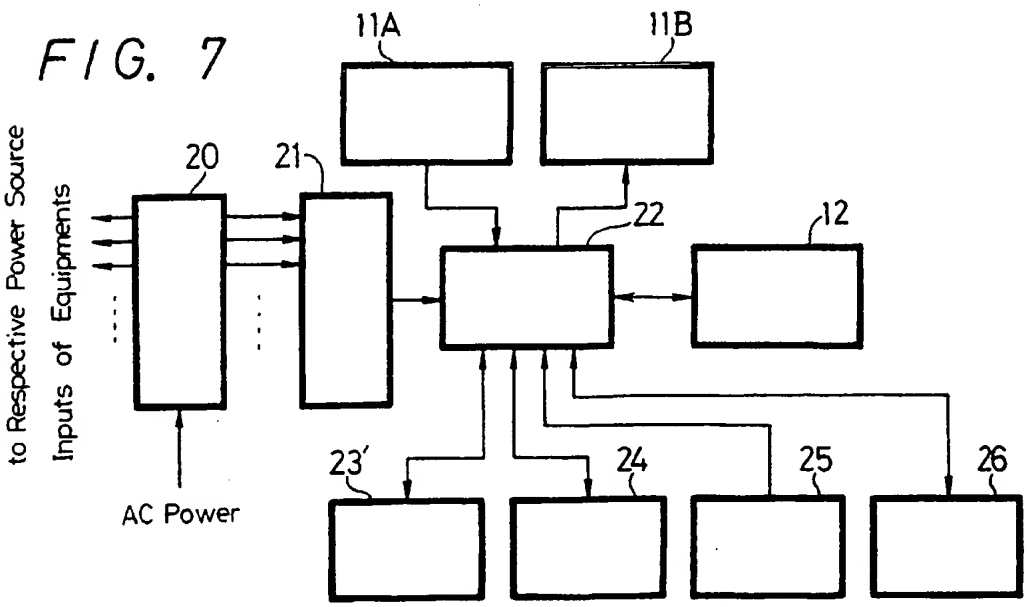

11A
11B
20
21
22
12
to Respective Power Source
Inputs of Equipments
AC Power
23'
24
25
26

FIG. 6

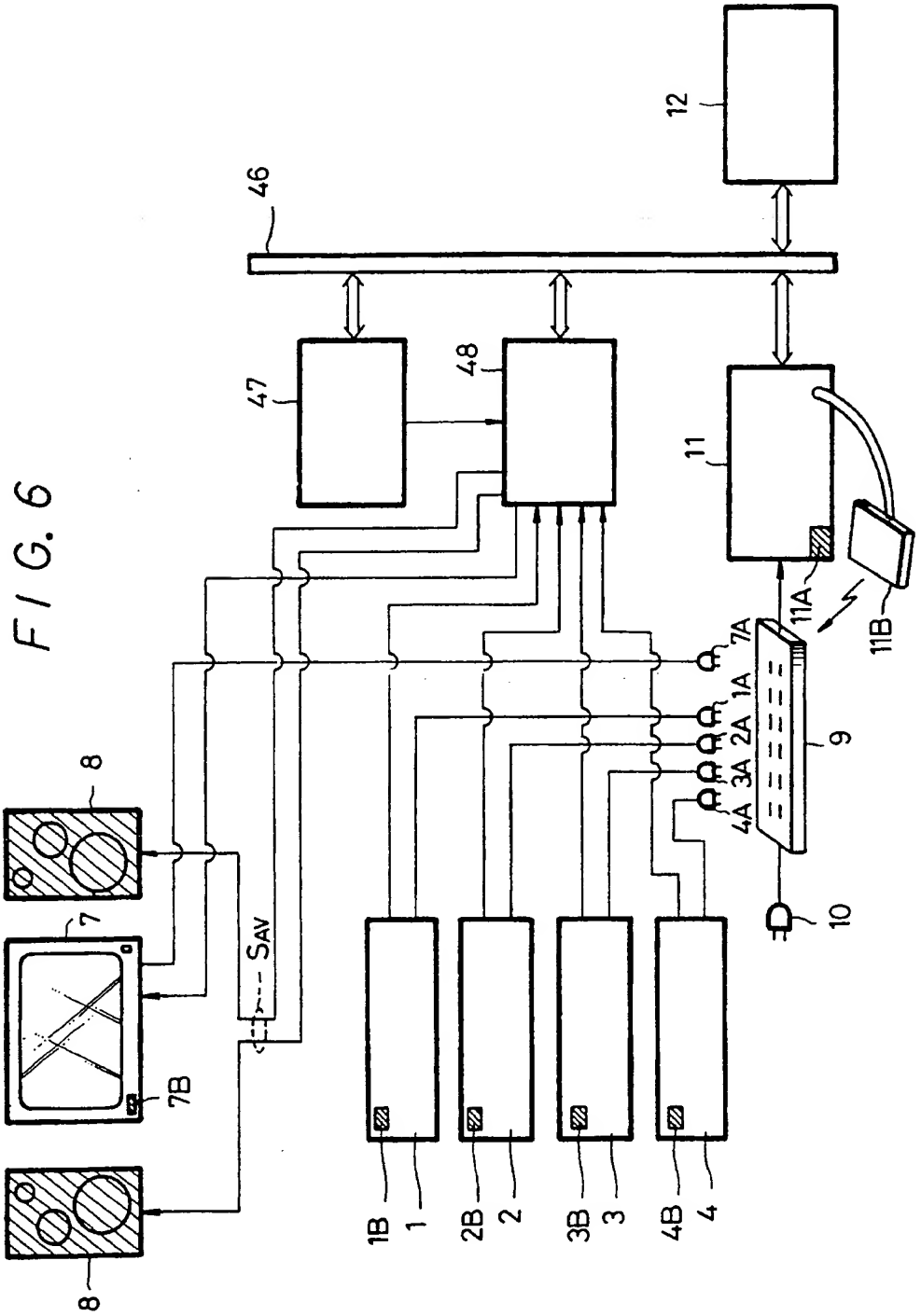


FIG. 8

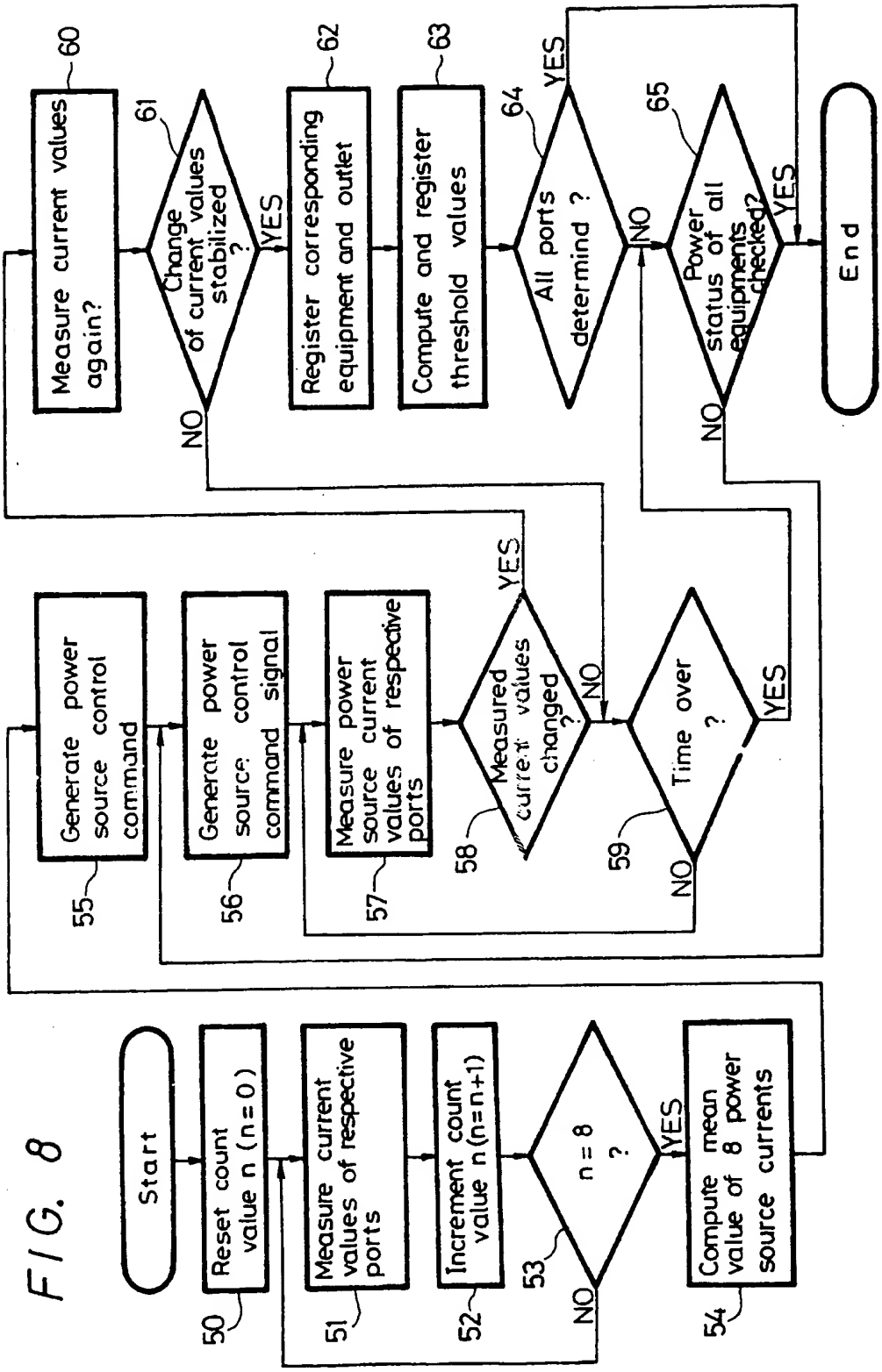

Start
Reset count value n (n=0)
Measure current values of respective ports
Increment count value n(n=n+1)
n = 8 ?
NO
YES
Compute mean value of 8 power source currents
50
51
52
53
54
Generate power source control command
Generate power source control command signal
Measure power source current values of respective ports
Measured current values changed ?
Time over ?
NO
YES
55
56
57
58
59
Measure current values again?
Change of current values stabilized ?
Register corresponding equipment and outlet
Compute and register threshold values
All ports determind ?
Power status of all equipments checked?
End
60
61
62
63
64
65

FIG. 9

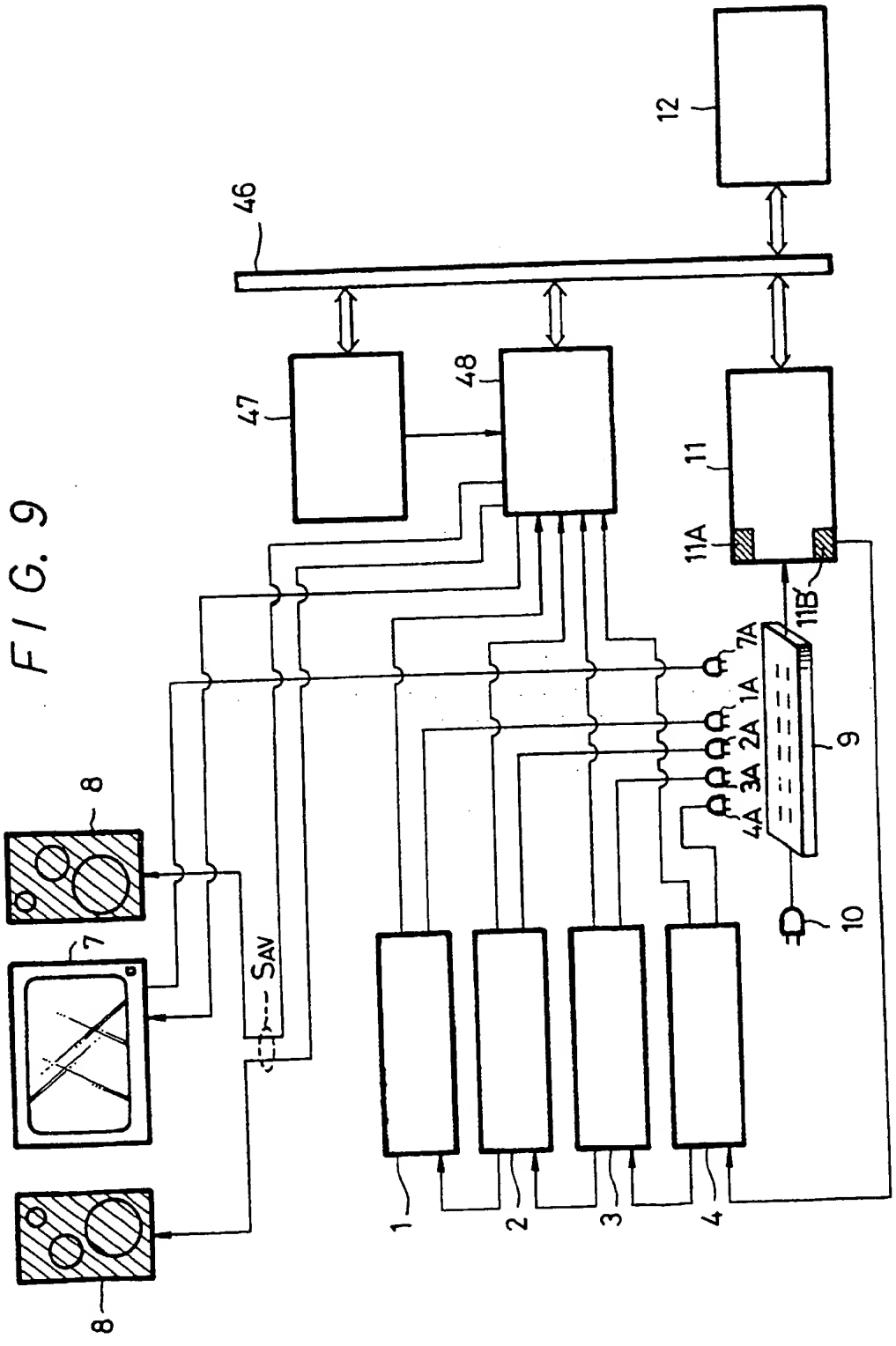


FIG. 10